

CLAIMS:

- 5 1. A seat-belt arrangement incorporating a seat-belt and an energy-absorbing force limiter, the force limiter comprising a first component and a second component, the first component presenting at least one friction surface, the second component presenting at least one co-operating surface, the friction surface and the co-operating surface lying immediately adjacent each other to
10 allow a predetermined relative movement of the first component relative to the second component, the force limiter incorporating a force applying mechanism to apply a force to urge said surfaces against each other, the force applying mechanism comprising at least one element of an electro-deformable material, and means to apply a potential to the said at least one element.
- 15 2. An arrangement according to Claim 1 where the or each element is a Piezo-electric element.
3. An arrangement according to Claim 1 or 2 wherein the force applying
20 mechanism comprises a stack of a plurality of said elements.
4. An arrangement according to any one of Claims 1 to 3 wherein a control arrangement is provided to control the potential applied to the said element or elements in response to at least one input signal.
- 25 5. An arrangement according to Claim 4 wherein the force applying mechanism includes at least one sensor element, to provide a potential in response to a force being applied by the said force applying mechanism, said potential being used as an input signal for the control arrangement.

6. An arrangement according to Claim 4 or 5 wherein the control arrangement includes a calculator to calculate a desired value of belt force within said seat-belt, and a device to measure actual belt force and includes a
5 comparator to compare the desired and the actual belt force to generate a control signal.

7. An arrangement according to Claim 6 wherein a force sensor is provided in a belt anchorage to measure the actual belt force.

10

8. An arrangement according to Claim 6 or 7 wherein the calculator is provided with one or more input signals from one or more sensors adapted to sense the weight of a seat occupant, the position of a seat occupant, the violence of an accident or the interaction of an air-bag.

15

9. An arrangement according to any one of the preceding Claims wherein the predetermined movement of the first component relative to the second component has one or two degrees of freedom.

20 10. An arrangement according to Claim 9 wherein the motion between the first component and the second component is an angular motion.

11. An arrangement according to any one of Claims 1 to 8 wherein the motion between the first component and the second component is substantially
25 linear.

12. An arrangement according to any one of the preceding Claims wherein the first component has a plurality of friction surfaces, and the second component has a plurality of co-operating surfaces.

13. An arrangement according to Claim 12 wherein the said surfaces are provided on lamellae which alternate with each other, the lamellae being mounted to be brought into firm engagement by the action of the said force
5 applying mechanism, alternate lamellae being fast with the first component and the second component respectively.
14. An arrangement according to Claim 13 wherein a first set of lamellae are mounted to rotate with the spool of a retractor for the seat-belt, and the
10 remaining lamellae are fast with the housing of the retractor.
15. An arrangement according to any one of the preceding Claims wherein the first component is the spool of a safety-belt retractor, and the second component is the housing of the safety-belt retractor.
15
16. An arrangement according to any one of Claims 1 to 12 wherein the first component includes at least one length of strap, and the second component includes a member which traps the strap against a fixed part, the force applying mechanism applying a force to said member tending to compress the strap
20 against said fixed part.
17. An arrangement according to any one of Claims 1 to 12 or 16, wherein the first component is adapted to be connected to an end of the seat-belt, and the second component is adapted to be connected to an anchoring point within a
25 motor vehicle.